

manifold and complex phenomena of life must, in the last analysis to which we can for the present hope to submit them, be considered as attributes of cellular activity.

"There is a solidarity in the essential phenomena of life which is shared not only by the simple *Amoeba*, but by the most specialised cell in a tissue of the human body."

As might be anticipated by those who will now become acquainted with the lectures for the first time, the consideration of the ferments, toxins, and other properties of the cell occupies an important part of the whole work. Prof. Macfadyen is best known by his investigations in this department of biology, and even if the point of view has somewhat changed during the last few years, it is hardly possible to read the book without profit. The method of treatment, as befits a course of lectures of this kind, is necessarily somewhat elementary, but it is not by any means superficial, and the thread of the argument can easily be followed by anyone, even though he have no special previous knowledge of the subject.

Great insistence is placed on the distinction between the reactions of living protoplasm and the molecular groups that arise out of it when the attribute of life has been lost. This is not always remembered sufficiently by some who would reduce all the phenomena of life to proximate questions of contemporary chemistry and physics, without reflecting on the limited area of these sciences that has been explored up to the present time.

"A great part of physiological inquiry has consisted in the examination and explanation, *not* of life but of the mechanism of life, and so far as this mechanism is concerned, adequate and satisfactory explanations have been found in the ordinary laws of physics. It is when we come to cellular activity that our real difficulties begin as regards the essentially vital problems."

Of course, this does not affect the truth of the statement that the greatest real advances have been actually made along the paths indicated by chemistry and physics, but rather that these two sciences occupy themselves as yet with relatively simple problems, whilst those that confront the physiologist are so complex that means have not as yet been discovered, at least in most instances, to split them up into those simpler and more manageable components into which analysis will one day assuredly cleave them. It may be that the requisite tool will be fashioned as the result of the investigations on ferments that are now being so energetically studied. At any rate, researches on these bodies are yielding, at the present time, results of far-reaching importance, and we have come to realise that it is by their agency within the living cell that many of the reactions that used to be associated essentially with "living" substance are demonstrably brought about.

The lectures deal with these and other topics. The style is always interesting, and the book may well claim to form an introduction to a study of some of the fundamental problems of biology, if not to biology itself.

INTERNAL COMBUSTION ENGINES.

- (i) *The Internal Combustion Engine*. By H. E. Wimperis. Pp. xiii+326. (London: Constable and Co., Ltd., 1908.) Price 6s. net.
- (2) *Internal Combustion Engines, their Theory, Construction, and Operation*. By R. C. Carpenter and H. Diederichs. Pp. xiv+597. (London: Crosby Lockwood and Son; New York: D. van Nostrand Co., 1908.) Price 21s. net.

(1) **T**HE developments of the theory and practice of engineering in relation to the internal-combustion engine have been so rapid in the last few years that old text-books are practically obsolete, and the serious student of this fascinating subject can only obtain trustworthy information by consulting a mass of original papers. The present text-books are of the class which will appeal to advanced students of engineering, and will also be welcomed by engineers who, without having a specialist knowledge of the subject, wish to keep abreast of modern developments.

Mr. Wimperis has dealt very successfully with a considerable range of theory and practice, and, in a moderate compass, has given a clear account of the theory of the internal-combustion engine. The distinctive feature of the early part of his work is the development of the thermodynamic equations on the assumption that the specific heat of the charge varies linearly with the temperature.

Modern research on the specific heats of gases at very high temperatures shows that a theory based on an invariable specific heat is so incorrect as to make the standard of reference of little value.

The exact way in which the specific heat of the charge varies has not been settled in a satisfactory manner, and it appears that the law of change is not a linear function of the temperature; but in the present state of our knowledge the extra complication produced by a parabolic formula is not warranted. The second section of the book is devoted to the construction and operation of gas engines and producers, and covers a fair range of practice. Some of the sections, such as that on the balancing of engines, merely touch the fringe of the subject, but balancing could not be adequately treated without materially adding to the size of the book.

We think that the author might have devoted more space to the consideration of indicators, especially to those which have developed from the diaphragm indicator invented by Prof. Perry, and which in their modern forms have become so important in tests of high-speed engines of all kinds.

Oil and petrol motors are dealt with in the final section of the book, and considerable space is devoted to carburettors, ignition, rating of petrol motors, and their efficiency. The book is clearly printed, the illustrations are well chosen, and it is one of the most interesting and readable works which has appeared for a very long time.

(2) The work by Profs. Carpenter and Diederichs, of Cornell University, is on a more extensive scale, and is based on a course of lectures to engineering students at Sibley College. It is therefore written

more from the point of view of a teacher, and, in its early chapters, the theory of the internal-combustion engine is developed on the assumption of a constant specific heat. Later the variation of the specific heat with temperature is discussed in general terms, and the results of Clerk, Mallard, and Le Chatelier are given.

The principal feature of the work, however, is the very full account of the growth and development of the internal-combustion engine in America.

All the well-known types are described and generally very fully illustrated. In this respect the work is somewhat encyclopædic in character, and ought rather to be regarded as a reference book than a text-book. The same remark applies to other sections devoted to fuels, testing of engines, methods of regulation, gas-engine auxiliaries, and the like. In all these we find a mass of information, with copious references to the original sources.

Anyone wishing to obtain a good general idea of present-day practice in America will find this book a valuable work.

E. G. COKER.

OUR BOOK SHELF.

Abhandlungen zur Physiologie der Gesichtsempfindungen aus dem physiologischen Institut zu Freiburg-i-B. Herausgegeben von J. von Kries. Drittes Heft. Pp. 192. (Leipzig: Verlag von J. A. Barth, 1908.) Price 6 marks.

THIS volume comprises the third series of collected papers from the laboratory of Prof. von Kries at Freiburg. The communications have all been previously published in the *Zeitschrift für Psychologie und Physiologie der Sinnesorgane*, the earliest having appeared in 1903. It is doubtful whether their republication in this form will lead to recognition by a larger audience, not because of any lack of inherent excellence, but rather because of their highly specialised nature.

The first paper is an interesting note on the perception of flicker in normal and totally colour-blind persons. The researches of Schatarnikoff tend to show that the retinal rods possess a lower sensitivity for rapid periodic variation in the intensity of the incident light than the cones; hence more rapid rotation of the disc in the usual method of eliciting the flicker phenomenon is necessary to produce complete fusion with the eye adapted for light than with the dark adapted eye. It became of interest, therefore, to investigate the behaviour of the totally colour-blind eye in these circumstances. At the suggestion of Prof. von Kries, who had not a suitable case under his observation, Prof. Uthhoff carried out some investigations. He found that much more rapid rotation—about three times—was necessary with the normal eye to eliminate flicker than with the totally colour-blind eye.

Porter has investigated the relationship between the intensity of illumination and the frequency of change necessary to eliminate flicker. He found that the curves representing this relationship show two parts, each nearly straight, but having two different constants. These curves are analogous to those obtained by König for the relationship between visual acuity and intensity of illumination. In the one case the fusion frequency, in the other the visual acuity, is proportional to the logarithm of the illumination. Both, therefore, behave in identical fashion: with the smallest intensities of light both increase slowly; at

approximately the same intensity a much more rapid increase suddenly becomes apparent. The simplest explanation of these phenomena is that there are two mechanisms at work, one of which is influenced by light of low, the other by light of higher, intensity.

In succeeding papers Dr. Wilhelm Trendelenburg records quantitative estimates of the bleaching of visual purple by monochromatic light and (with Dr. Roswell P. Angier) of mixtures of complementary colours to form white. Siebeck has investigated the intensity of monochromatic light in extremely small fields, so small, in fact, as to eliminate the colour element (*Minimalfeldhelligkeit*). Prof. von Kries, in a paper founded on observations by Dr. Eyster, calculates in absolute terms the energy necessary for stimulation of the retina, and Dr. F. P. Boswell applies the same principles to the fovea. They thus attempt what has already been done for the ear by Lord Rayleigh and others. Other papers on colour mixtures and colour memory will repay perusal, and Prof. von Kries describes a simple apparatus for the mixture of monochromatic lights which may be commended to the notice of teachers of physiological psychology.

Fresh-water Algae from Burma, including a few from Bengal and Madras. By W. West and G. S. West. Pp. 175-260; 7 plates. (Annals of the Royal Botanic Garden, Calcutta, vol. vi., part ii.) Price Rs. 10, or 15s.

THE material was collected in certain districts of Burma, and a few species in the Burdwan district of Bengal and Vizagapatam district of Madras by Mr. I. H. Burkill, and was forwarded for determination by Lieut.-Col. Prain, at that time director of the Botanical Survey of India. The work is almost entirely systematic, as would be expected in dealing with material from districts where the algal flora was previously almost unknown, and has added very materially to our knowledge of the distribution of fresh-water algæ in the Indian region. Two new genera are described—*Euastridium*, a large and handsome Desmid. possessing peculiar morphological features, and *Burkillia*, belonging to the *Protococcaceæ*, occurring as free-floating colonies furnished with stout horns. Among the many new species described, *Mougeotia producta* is of special importance because of the presence of aplanospores in no way different from those which are found in the genus *Gonatonema*. In the last-named genus aplanospores only are formed, whereas in *Mougeotia*, aplanospores and spores, as a result of conjugation, are both present, hence it may be necessary to place *Gonatonema* merely as a section of the genus *Mougeotia*, in which spores resulting from conjugation have ceased to exist. *Urococcus tropicus* is remarkable in being green, whereas the cells of other species of the genus usually contain an abundance of a red-brown pigment.

The collection contained a number of interesting Desmids which, with previous records, are said to furnish material for a very interesting discussion on their distribution in the East Indies generally. Even from the knowledge forthcoming, certain Desmids appear to be confined to an area extending from India and Ceylon, across Burma and the Malay Peninsula to Sumatra and Java, and thence to Queensland.

As evidence of the wide geographical range of some species of algæ, *Nostoc humifusum*, first recorded from Scotland, and *Plectonema wollei*, from the United States, were included in the collection.

The number of varieties and forms hovering around many of the species suggests that, from the standpoint of de Vries, many incipient species are being produced.